GLOBAL HAWK (RQ-4)

2003 DT/OT Status Report

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OVERVIEW

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- Test and Evaluation Status
  - Overall
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INTRODUCTION
Purpose

- This report provides a status update on the Global Hawk (RQ-4A) Spiral 1/Production Lot 1 Engineering and Manufacturing Development (EMD) Combined Developmental Test (DT)/Operational Test (OT) program activities during Fiscal Year 2003 (FY03).

INTRODUCTION
Background

- Global Hawk EMD Program evolved from the Defense Advanced Research Projects Agency (DARPA) High Altitude Endurance (HAE) UAV Advanced Concept Technology Demonstration (ACTD).
  - The ACTD program was conducted between 1996 and 2000.
- Global Hawk demonstrated sufficient system-level maturity (i.e., safety of operations and payload maturity) to warrant transition directly to the EMD phase in March 2001.
- Spiral development approach used to evolve capabilities into a fully Operational Requirements Document (ORD)-compliant system
  - Supports rapid deployment of the Global Hawk intelligence, surveillance, and reconnaissance (ISR) capability to the warfighter system further evolves through additional spirals as technologies mature

INTRODUCTION
Background

- The FY03 EMD Combined DT/OT program was originally scoped to evaluate Spiral 1 capabilities that would be incorporated into the Production Lot 1 air vehicles (Production 1 and 2) and ground segment (AF MCE #1 and AF LRE #1).
- As a result of Operation Iraqi Freedom (OIF), Air Combat Command added requirements to the Spiral 1 baseline for incorporation prior to the stand-up of the main operating base (MOB) at Beale AFB, California.

INTRODUCTION
Test Item Description

- Global Hawk EMD Program evolved from the Defense Advanced Research Projects Agency (DARPA) High Altitude Endurance (HAE) UAV Advanced Concept Technology Demonstration (ACTD).
- The ACTD program was conducted between 1996 and 2000.
- Sufficient Global Hawk system-level maturity (i.e., safety of operations and payload maturity) was demonstrated to warrant approval to transition to the EMD phase in March 2001.

INTRODUCTION
Test Item Description (Concluded)

Global Hawk Spiral 1/Lot 1Capabilities	Requirement Source
Open System Architecture (OSA) Hooks - Power and Discrete Controllers (PDCs) - Integrated Mission Control Computers (IMMCs) - Harness Changes	Spiral 1
Integrated Mission Management Computer (IMMC) / Programmable Discrete Controllers (PDCs)	
Mission Planning, including Automatic Contingency Generator (ACG)	
Synthetic Aperture Radar (SAR) Payload Improvements (diminishing vendors) - ASARS-2A Improvement Program (AIP)	
Electro-Optical (EO/IR) Improvements (diminishing vendors)	
Preliminary Global Air Traffic Management (GATM)	
UHF Demand and Multiple Access (DAMA) Software	
Technical Orders and Training	
See and Detect / Nose Infrared (IR) Video Camera	
Communication Improvements - Ku Band Data Link - 274 Mbps Common Datalink (CDL) - Extended Tether Program (ETP)	
Reachback	Operation Iraqi Freedom (OIF)
Secret Internet Protocol Router Network (SIPRNET) Chat	
Air Defense Systems Integrator (ADSI) Display	
International Marine/Maritime Satellite (INMARSAT)	
Manual Collection Management (MCM) – Data Analysis Workstation (DAWS) Replacement	

NOTE: Detailed descriptions of these capabilities are contained in Attachment 1

DT/OT STATUS
Overall

- Global Hawk EMD Spiral 1/Lot 1 test program is currently behind the originally planned Spiral 1 schedule
  - Rapid transition from ACTD to EMD
  - Impacts of Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF)
    - Diversion of test aircraft and resources to support conflicts
    - Reachback Demonstration Test Acceleration
    - GH Pilot training
    - Addition of OIF requirements to the Spiral 1 baseline
  - Challenges in production system development
    - Automatic Contingency Generator (ACG)
    - EO/IR development and production
    - ASARS Improvement Program (AIP) development
    - Technical Order V&V

DT/OT STATUS
Overall

- **Capability Additions from ACTD thru Spiral 1/Lot 1**

Capability	ACTD	Lot 1 (Apr 03)	Replanned Lot 1
IMINT	EO/IR/SAR	Initially SAR Only	EO/IR/SAR
SIPRNET chat	Yes	No	Yes*
ADSI	Yes	No	Yes*
INMARSAT	Yes	No	Yes*
LR-100	Yes	No	No
Manual Sensor Control	Via engineering tool	Phased after delivery	MCM at delivery
Mission Planning	Manual conting planning	Phased ACG delivery	ACG at delivery
Training	All OJT	Initial training on interim capability	Production baseline training
			* assumes IFF funding

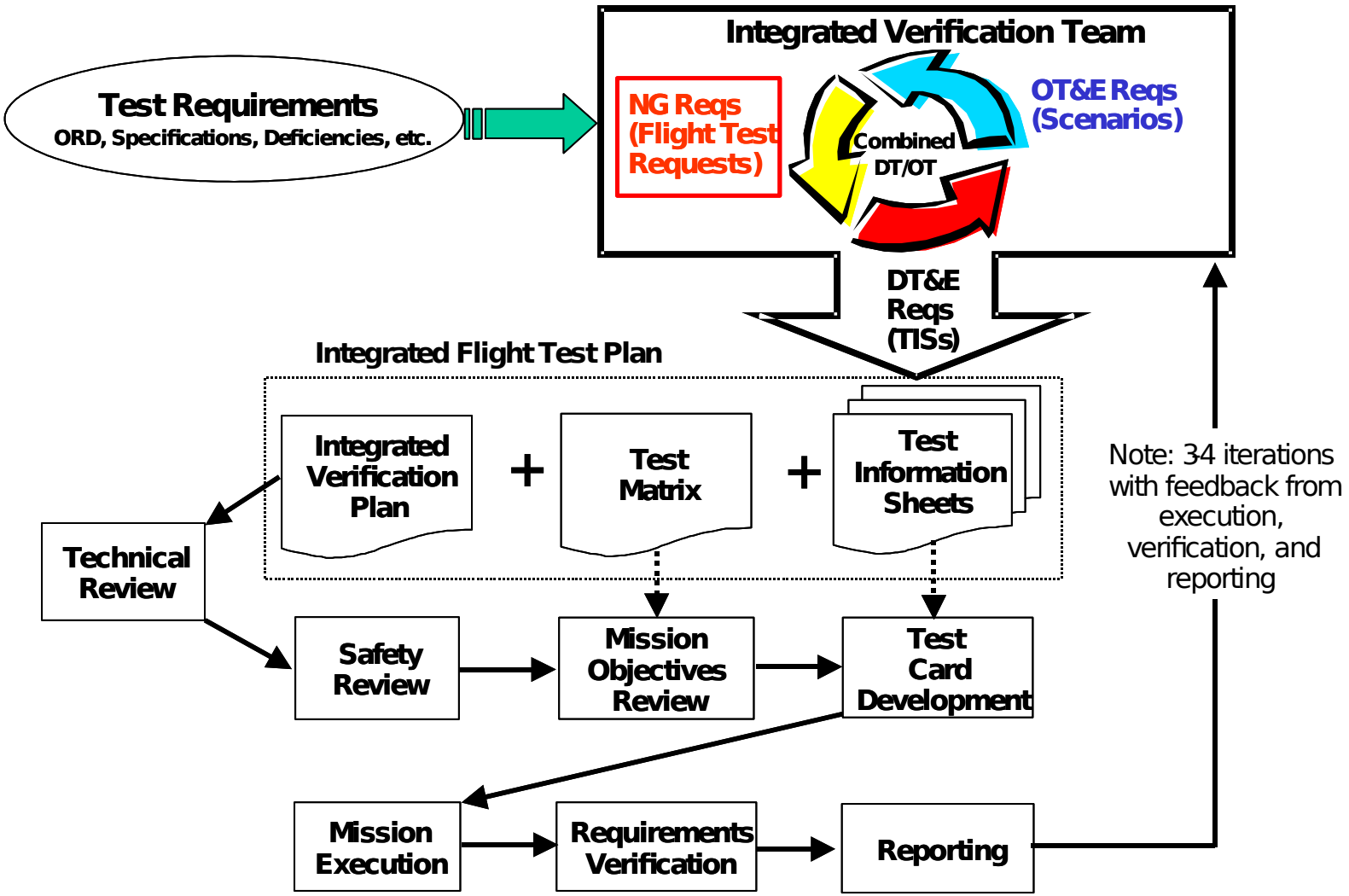
DT/OT STATUS
Significant Accomplishments

Event	Planned Date	Actual/Projected Date	Comments
ORD Completion	1 October 2002	30 October 2002	
TEMP Completion	1 November 2002	19 December 2002	
Integrated Flight Test Plan Completion	1 October 2002	On-Going	Test Information Sheets (TISs) added incrementally as requirements become available
UAV-7 First Flight	5 December 2002	14 February 2003	
System Specifications Approved	1 January 2003	25 September 2003	
First EMD Test Flight	1 February 2003	10 October 2003	
P-1 First Flight	10 June 2003	9 September 2003	
P-2 First Flight	11 September 2003	4 December 2003	
EMD Flight Test Completion	1 September 2003	30 March 2004	
Beale Stand-Up	17 May 2004	17 May 2004	
Operational Assessment	1 August 2004	1 September 2004	Threshold Dates: Jan-Feb 05

DT/OT STATUS
Test Planning

- Implemented “seamless verification” approach to combine DT&E and OT&E test requirements to the greatest extent possible in an effort to reduce acquisition cycle time
  - Implemented Integrated Verification Team (IVT) with participation from:
    - 452nd Flight Test Squadron, Responsible Test Organization (RTO)
    - AFOTEC Detachment 5, Operational Test Agency (OTA)
    - ASC/RG, Global Hawk System Program Office (SPO)
    - Northrop-Grumman Integrated Systems (NGIS), Global Hawk prime contractor.
  - Responsibilities include:
    - Serving as a clearinghouse for flight test requirements
    - Developing and maintaining the Test & Evaluation Master Plan, Integrated Flight Test Plan & Test Information Sheets (TISs)
    - Tracking test progress and completion status
    - Reporting significant test results/deficiencies

DT/OT STATUS
Test Planning



DT/OT STATUS
Test Planning

- Rapid transition from ACTD to EMD created significant degree of “concurrency” in the system engineering process with respect to requirements verification, system/subsystem design and development, and production.
  - Air vehicle and ground segment production was well ahead of system specification and definition of verification requirements definition. Consequently, test requirements were not available in a timely manner to efficiently plan test activities.
  - The IVT used the current ORD requirements to develop the anticipated TISs and resolve disconnects when verification requirements were ultimately defined.
  - The net effect is was, and remains, an incremental addition of TISs as specification verification requirements become available via Northrop-Grumman Integrated Systems (NGIS) development of test verification requirements in the form of Flight Test Requests (FTRs).

DT/OT STATUS
Test Planning

- Developed Integrated Flight Test Plan and Test Information Sheets (TISs)
  - Test Objectives
    - Verify the Global Hawk system meets user requirements as specified in the ORD for Lot 1.
    - Verify that the Global Hawk system meets Lot 1 specification and contractual requirements.
    - Verify proper implementation of new components or changed/improved capabilities.
    - Verify no regression of baseline ACTD system performance during spiral development, only additional improvements, where required is retained during spiral development.
    - Assess operational safety, suitability, effectiveness (OSS&E), suitability and interoperability of the Global Hawk integrated system.
    - Support Operational Test Readiness certification IAW a tailored AFMAN 63-119 process for the Operationa Assessment (OA), and later, dedictated IOT&E.

DT/OT STATUS
Test Planning

- Developed Integrated Flight Test Plan and Test Information Sheets (TISs)
  - Test Types
    - Contractor Production Acceptance Testing: Verify that the Global Hawk System meets specification/contractual and basic airworthiness requirements for DD-250 buy-off of the production aircraft.
    - System Performance Verification and Characterization: These tests will verify ORD requirements, with emphasis on the critical technical parameters and key performance parameters, and proper operation of new spiral components or changed/improved capabilities (traditional DT).
    - Logistics Test and Evaluation: These tests will assess the maintainability and supportability of the aircraft, ground (MCE, LRE), and support segments through evaluation of Built-in-Test System (BITS), servicing, hardware demonstrations, MCE and LRE deployability, support equipment, and sortie generation.
    - Technical Order Verification and Validation: The TOV&V will be accomplished for the Global Hawk Flight Manuals and “O” Level technical orders developed for the Global Hawk System.
    - Integrated System Evaluations (ISEs): These tests will assess operational effectiveness, suitability and interoperability of the Global Hawk integrated system. An ISE exercises system capabilities in an operationally realistic mission scenario.

DT/OT STATUS
Test Planning

- Developed Integrated Flight Test Plan
  - Test Information Sheets (TISs)

DT/OT STATUS
Test Planning

- Test Information Sheets

Series No.	TIS No.	Name	Number of Flight Test Points	Number of Ground Test Points	Status
1000		**Ground Test Operations**			
	1001	Safety-of-Flight Engine Run		3	Complete
	1002	Taxi Tests		8	Complete
	1003	Autonomous Takeoff Abort Demonstration		2	Complete
1100		**In-Flight Operations**			
	1101	Basic Airworthiness	6		Complete
	1103	Stability and Control	8		Complete
	1104	Navigation Accuracy	4		Complete
1200		**Integrated Sensor Suite (ISS)**			
	1201	EO/IR Basic Functionality	??		Ready to Execute
	1202	SAR ISS and SSR Developmental Test and Basic Functionality	12		Ready to Execute
	1203	ISS Interoperability	??		TIS in Development
	12XX	ISS SAR Characterization	??		Awaiting Requirements
	12XX	ISS EO/IR Characterization	??		Awaiting Requirements
1300		**Communications**			
	1301	Baseline Communication Functions	100		Ready to Execute
	1302	Voice Communications	26	4	Ready to Execute
	1303	Data Communications	32	12	Ready to Execute
	1305	Ground Station Interoperability	10		Not Complete
	1306	Ground Station Communications Subsystems	4	??	Ready to Execute
	1308	Reachback	16	15	Complete
	1309	UHF DAMA	15	30	Ready to Execute
	1310	ATC Radio Certification	29		Ready to Execute
1400		**Vehicle Subsystems**			
	1401	ECS	1		Complete

DT/OT STATUS
Test Planning

Series No.	TIS No.	Name	Number of Flight Test Points	Number of Ground Test Points	Status
1500		**Global Air Traffic Management (GATM)**			
	1501	Digital Air Data System (DADS) – Reduced Vertical Separation Minimum (RVSM) Performance	10		Complete
	1502	Traffic Alert and Collision Avoidance System (TCAS)	5	7	Ready to Execute
	1503	GPS RAIM and Navigation Airworthiness	11	12	Ready to Execute
	1504	ATC VHF 8.33 kHz Channel Spacing and Guard Channel Monitoring	2	3	Ready to Execute
	1505	IFF Transponder Performance	7	14	Ready to Execute
	1506	VHF ATC Frequency Modulation Immunity (FMI)	1	2	Ready to Execute
	1507	See and Detect	6		Ready to Execute
	1508	Emergency Locator Emitter		2	Ready to Execute
	1509	Military Selective On-Off Capability		1	Ready to Execute
1600		**Performance and Flying Qualities**			
	1601	Delta Velocity	?		TIS in Development
	1602	Wet Runway Testing	?		TIS in Development
	1605	Crosswind Operations	17		Ready to Execute
1800		**Mission Planning**			
	1801	Mission Planning		1	Ready to Execute
	1802	12-Hour Mission Planning Capability		1	Ready to Execute
	1803	Preflight Loading and In-flight Updates of Mission Data	1	2	TIS in Development
	1804	Compatibility With Air Force Mission Planning Systems		1	Ready to Execute
	1805	Payload Retasking with Manual Collection Management	1	2	Awaiting Requirements
	1806	Automatic Contingency Generator (ACG)	??	??	TIS in Development
2000		**Logistics**			
	2001	BITS Suitability			Ready to Execute
	2002	Servicing			Ready to Execute
	2003	Hardware Demonstrations			Ready to Execute
	2004	MCE Supportability			Ready to Execute
	2005	LRE Supportability			Ready to Execute
	2006	Sortie Generation			Ready to Execute

DT/OT STATUS
Test Planning

Series No.	TIS No.	Name	Number of Flight Test Points	Number of Ground Test Points	Status
2100		**Technical Order Verification and Validation (TOV&V)**			
	2101	Flight Manual Verification	N/A	13	Ready to Execute
	2102	Aircraft Job Guide Verification	N/A	34	Ready to Execute
2200		**Reliability and Maintainability**			
	2201	Reliability and Maintainability	N/A	N/A	Ready to Execute
3000		**Integrated System Evaluations (ISEs)**			
	3001	Logistics			TIS in Development
	3002	Collocated Operations			TIS in Development
	3003	Reachback Operations			TIS in Development
	3004	Exercise Profile			TIS in Development
	3005	Survivability			TIS in Development
	3006	Mission Planning			TIS in Development
	3007	Airfield Interoperability			TIS in Development
	3008	Tasking, Processing, Exploitation and Dissemination (TPED)			TIS in Development
3100		**Human Factors**			
	3101	Safety – Warnings and Cautions			Ready to Execute
	3102	Ground Station			Ready to Execute
	3103	Safety – Flight Safety			Ready to Execute
	3104	Command, Control, and Communications			Ready to Execute
	3105	Communications Security (COMSEC) – Secure Communications			Ready to Execute
	3106	Communications/Emergency IFF Procedures			Ready to Execute
	3107	Ground Station Communications Subsystems			Ready to Execute
	3109	Mission Execution			Ready to Execute
	3110	Payload Characteristics			Awaiting Requirements
	3111	See-and Detect Camera			Ready to Execute
3200		**Climatic**			
	3201	Rain Intrusion	22		Complete
3300		**Propulsion**			
	3301	JP-8+100 Fuel	2	5	TIS in Development

DT/OT STATUS
Test Execution

- Significant results
  - UAV-7 First Flight — 14 February 2003
  - First EMD Test Flight — 10 October 2003
  - P-1 First Flight — 9 September 2003
  - P-2 First Flight — 4 December 2003
- XX sorties for XX flying hours
- XX% complete with available test points. (ADD TEST POINT BURNDOWN)
- Awaiting capability delivery and test requirements definition.
  - Paced by availability of the production ISS and ACG/MCM software

DT/OT STATUS
Test Execution

- Significant results
  - UAV-7 First Flight — 14 February 2003
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DT/OT STATUS
Projection

- Add Flight Test Inchstone
- Complete Combined DT/OT

CONCLUSIONS AND RECOMMENDATIONS

- Overall
  - Behind original schedule due to OIF and addition of OIF requirements.
  - Concurrency in system engineering process has put us behind the power curve – testable assets before test requirements
- Test Planning
  - Stood-up Integrated Verification Team (IVT)
  - Developed TEMP and Integrated Flight Test Plan (IFTP)
  - Paced by definition of test requirements for: Production EO/IR/SAR characterization, MCM, ADSI, SIPRNET, INMARSAT

CONCLUSIONS AND RECOMMENDATIONS

- Test Execution
  - Significant results
  - XX sorties for XX flying hours
  - XX% complete with available test points. Awaiting capability delivery and test requirements definition.
  - Paced by availability of the production ISS and ACG/MCM software

CONCLUSIONS AND RECOMMENDATIONS

- Requirements Verification
  - ORD CTP/KPPs: Pending completion of Functional Configuration Audit process.
  - OIF Requirements: Awaiting contractual incorporation and definition of verification requirements
  - OA Entrance Criteria: Stabilized performance key issue
- Projection
  - Completion of Combined DT/OT to support OA threshold dates (1 Jan 05)